National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service
Polar Orbiting Environmental Satellite Ground System (POES GS)
006-48-01-15-01-3208-00-104-010
Operational Analysis
FY 2010

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Executive Summary

The Polar-orbiting Operational Environmental Satellite (POES) mission operates the National Oceanic and Atmospheric Administration (NOAA) constellation of environmental satellites in circular, near-polar, sun-synchronous orbit. These satellites provide scheduled down-loads of environmental data collected from space to the POES Ground System (GS) for satellite monitoring, control, mission data processing, analysis, and distribution. The POES GS assures continuous data coverage to provide an uninterrupted flow of critical global information used for land, ocean, atmospheric, and space environment applications in support of the meteorological, hydrological, marine, agricultural, transportation, and energy user communities.

The POES GS technology is periodically refreshed as equipment becomes obsolete and is no longer supported. Old technology is replaced with new technology which sustains the capability of the POES GS. POES GS also takes on additional challenges and requirements to support new missions and new agreements. These activities are not part of the Operational Analysis discussion. However, once development on a new operational system component is complete, operational support for that component is provided through the POES Ground System until transferred to the appropriate NESDIS Office.

POES GS is addressing any gap in the NOAA Planning, Programming, Budgeting and Execution System (PPBES) service components “MS-STP-PTP POES Total Program” and “MS-SSV-PSO Ingest/Process Satellite Observations” by extending Metop Support through 2015 to maintain continuity of data and services. Thus, NOAA/NESDIS, in conjunction with other participating entities, will maintain continuity of the polar system.

This operational analysis (OA) report is an annual, in-depth review of the performance of the tasks needed to fulfill the requirements that are levied on the POES GS. The POES GS FY10 major achievements are:

- Replaced the Satellite Operations Management Subsystem (SOMS) servers and workstations, and upgraded to a newer version of the operating system.
- Replaced the multi-mission L&S Band receivers at the Fairbanks CDAS to increase efficiency and scalability of the POES GS program to support future data streams’ operational requirements.
- Operationally installed two First Article Satellite Telemetry Processor Frame Synchronizer (STPFS), one at SOCC, and one at the Wallops CDAS
- Provided support to Ocean Surface Topography Mission (OSTM) by working with the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) on Jason-2 and Jason-3 support and the Constellation Observing System for Meteorology Ionosphere and Climate (COSMIC) international agreements
- Provided upgrade support at Fairbanks CDAS for the US Geological Survey Landsat Data Continuity Mission (LDCM) mission.
- POES GS FY2010 operational expenditures remained within the 10% monitoring threshold of the work plan budget.

This operational analysis (OA) is an annual, in-depth review of the POES GS program’s steady state performance based on the following: Customer Results, Strategic and Business Results, Financial Performance, and Innovation.

This report focuses on the operational state of the program as of September 30, 2010, and is based on guidance developed by the Department of Commerce. The POES GS program directly facilitates Department of Commerce Goal 3.1 to "Advance understanding and predict changes in the Earth’s environment to meet America’s economic, social and environmental needs” and NOAA’s Strategic Goal to “Serve society’s needs for weather and water information”. The current program meets established cost, schedule and performance parameters.

1.0 Customer Results

The POES GS program is fully meeting the customer's needs and the program is delivering the satellite services as outlined in the NOAA/NESDIS/OSD/GSD Environmental Satellite Ground Systems Program Plan. The POES Ground Systems primary customers are the Satellite Operations Control Center (SOCC), the Wallops, VA and Fairbanks, AK Command Data Acquisition Stations (CDAS), and the Environmental Satellite Processing Center (ESPC). The POES Ground System provides satellite monitoring, control, mission data processing, analysis, and distribution services to ensure that the end-user systems receive the required data and it is timely and complete.

1.1 Customer Requirements

The customer's requirements are summarized in the NOAA/NESDIS/OSD Ground Systems Division Program Plan. The GSD Program Plan is updated regularly and the current version is being reviewed by OSD.

The customer's detailed technical requirements are discussed in Technical Interface Meetings (TIM), Preliminary Design Reviews (PDR), and Critical Design Reviews (CDR). These requirements are documented and referenced in all phases; and the requirements are traced to all tests which include unit tests, on-site tests, end-to end tests and system tests. All documents are configuration managed and archived in a library for customer use. For example, IJPS/CSU task documents are stored on a password protected website for the customers' review.

The customer's business requirements are an input to the development of all technical requirements and ensure that the overall operational performance of the POES GS system continues to meet the customer's business requirements.

1.2 Performance Measures

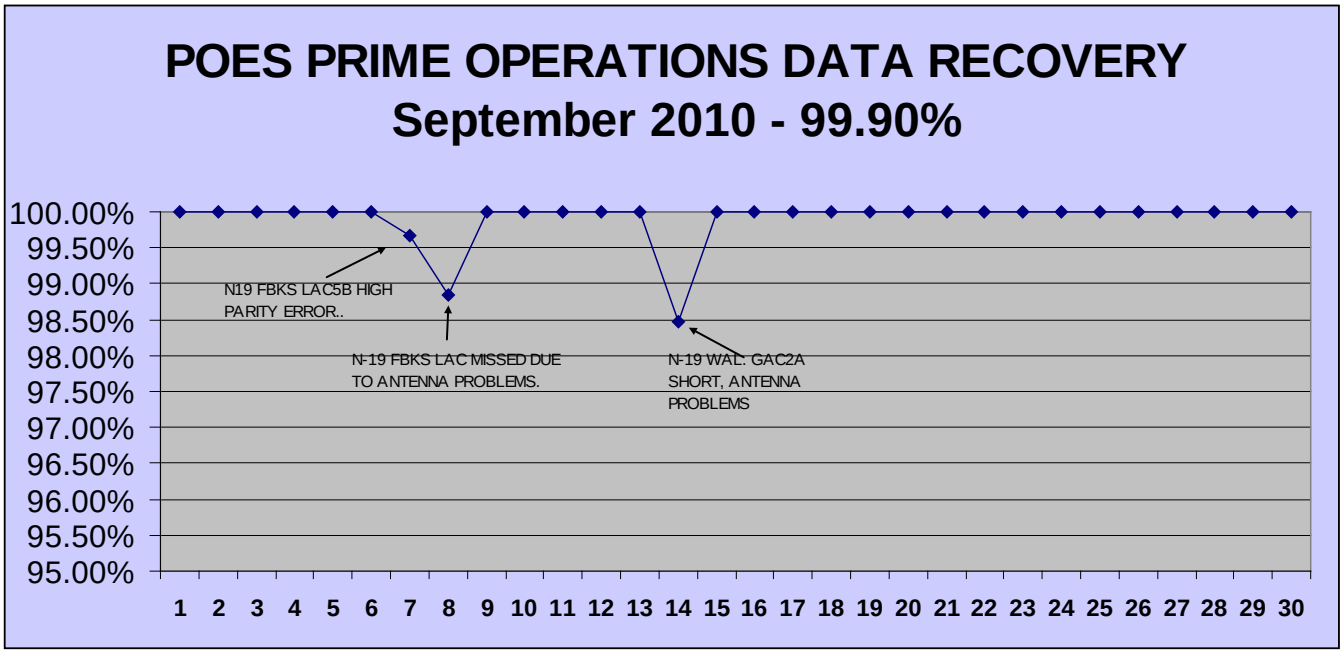
The POES GS is responsible for ensuring continuous data coverage to provide an uninterrupted flow of critical global information to its customers. POES GS data and products created from POES data is used for land, ocean, atmospheric, and space environment applications in support of the meteorological, hydrological, marine, agricultural, transportation, and energy user communities. Timeliness and completeness of the data are the two key metrics by which customer results are judged in the POES-GS environment. The POES GS Customer Results performance measurements for FY 2010 are provided below in Table 1.

Table 1: POES GS Customer Results Performance Measures for FY2010

Measurement Area	Indicator	FY10 Baseline	FY10 Actual Result	Comments
Customer Results	Percent of total POES data recovered meeting quality requirements.	98.5%	99.8%	+1.3% over baseline as of 09/30/2010
Processes and Activities	Percent of POES data delivered meeting quality / timeliness requirements delivered to ESPC within two hours.	90%	99.7%	+9.7% over baseline as of 09/30/2010

Source of Table 1 data is the Office of Satellite Operations (OSO) performance chart for September 2010. POES-GS annual performance targets and monthly results are also contained in the POES-GS OMB BY12 Exhibit 300, Section II.E, and the POES-GS IT Dashboard.

Figures 1 and 2 illustrate the percentage of available data that was recovered every day in September 2010. Figure 1 shows the percentage of data recovered daily by the NOAA-19 polar satellite. Figure 2 summarizes the daily data recovery percentages for every operational Polar satellite. Both figures annotate anomalies that occurred during the month.



Source: NESDIS Monthly Review - September 2010, NOAA OSO Monthly Report briefing, draft 10/08/2010

Figure 1: POES GS September 2010 Daily Data Recovery for Satellite NOAA-19, the primary PM Polar Environmental Satellite

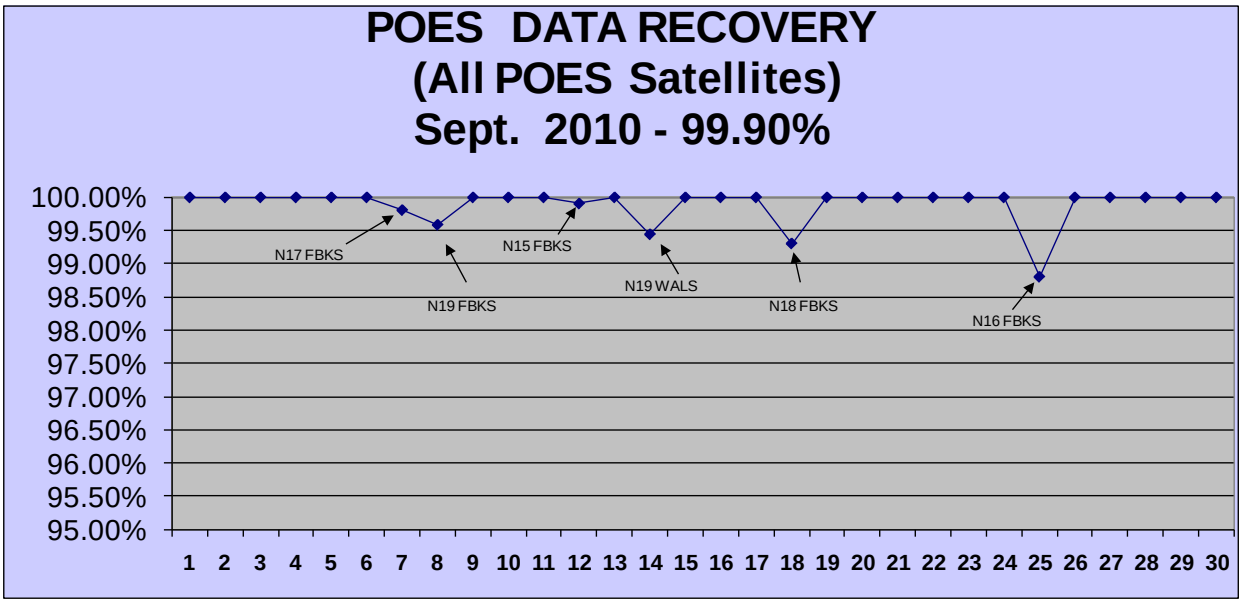


Figure 2: POES GS September 2010 Daily Data Recovery for all NOAA Polar Satellites

Below is a recent NPOAA OSEI Image of the Day. It has been reduced in size for display purposes. Additional information about the Polar orbiting satellites is available at http://www.osd.noaa.gov . Additional images generated by the NOAA Environmental Visualization Laboratory from NOAA environmental satellite data downloads are available at http://nnvl.noaa.gov/imageoftheday.php

Figure 3: Image created from data downloaded from the Polar Metop environmental satellite

Figure 1 is a POES image of Hurricane Earl off the east coast of the United States. The data was captured by the AVHRR instrument onboard EUMETSAT's Metop-A polar-orbiting satellite on September 1, 2010. Hurricane Earl quickly closed in on a large part of the US east coast on September 1, 2010 as tens of thousands of people were ordered to evacuate.

2.0 Strategic and Business Results

This report focuses on the operational state of the NOAA NESDIS OSD GSD polar environmental satellite ground systems program as of September 30, 2010, and is based on guidance developed by the Department of Commerce (DOC). The POES GS program directly facilitates DOC Goal 3 to "Advance understanding and predict changes in the Earth's environment to meet America's economic, social and environmental needs." The current program meets established cost, schedule and performance parameters.

The POES GS program is meeting its own goals and objectives as well as those of NOAA NESDIS. Program management and controls are in place to ensure the program continues to meet its goals and objectives and monitor the performance of POES GS.

2.1 POES GS Helps to Achieve Strategic Goals

The POES GS program directly facilitates the NOAA Strategic Goal to "serve society's needs for weather and water information." To accomplish this goal requires sustained capability to monitor the health and safety of the POES satellites and ensure the timeliness of transmission of polar environmental satellite data to the OSO Environmental Satellite Processing Center (ESPC).

POES GS also directly supports NOAA's obligations under international agreements; the program is a leader in meeting mission objectives at a lower cost to the US Government by collaborating with international space agencies. This collaboration achieves economies of scale in the acquisition and distribution of global weather and water information, while promoting mutually beneficial international cooperation.

Initial Joint Polar–orbiting Operational Satellite System (IJPS) began with the commissioning of the first Metop satellite in 2006. NOAA entered into an agreement with EUMETSAT for participation in the IJPS. In the IJPS Agreement, NOAA and EUMETSAT agreed to procure and operate their Polar-orbiting satellites in a manner beneficial to both parties and the world's meteorological community. EUMETSAT, working together with the European Space Agency (ESA), developed the meteorological satellites (Metop series 1-3) to be flown consecutively in a Polar orbit with a morning (A.M.) equatorial crossing time. The Metop satellites comprise the space segment of the EUMETSAT Polar System. The morning and afternoon satellites have a set of jointly provided common instruments. In addition, instruments specific to each orbit was provided by NOAA and EUMETSAT for their respective satellites. The IJPS agreement also commits NOAA and EUMETSAT to provide support for each other's operational satellite through their respective ground segments for commanding, receiving telemetry and global data, as well as exchanging data between the two Polar satellite systems.

The National Aeronautics and Space Administration (NASA), NOAA, the Centre National D'Etudes Spatiales (CNES) of France, and the European Organization for Exploitation of the Meteorological Satellites (EUMETSAT) jointly cooperated in the Ocean Surface Topography Mission (OSTM). The current operational OSTM satellite is JASON-2. NOAA/NESDIS OSO and OSD/POES GS provide the control center for the satellite, command and data acquisition (CDA) stations, and data processing, archiving, and distribution infrastructure for OSTM.

National Space Organization (NSPO) of Taiwan, NOAA, and the Office of Systems Development University Corporation for Atmospheric Research (UCAR) work together on the Constellation Observing System for Meteorology Ionosphere and Climate (COSMIC) program. UCAR implemented the COSMIC Program, Constellation Observing System for Meteorology, Ionosphere and Climate in 1998. The COSMIC Program involved the design, development, integration and test (I&T), and launch of a constellation of six small research

satellites carrying three scientific payloads: a GPS Occultation Receiver, Tiny Atmospheric Photometer (TIP), and a Tri Band Beacon (TBB) transmitter. The COSMIC satellites were launched on April 14, 2006. POES GS recently added two 5 meter antennas at Fairbanks CDA to improve the reception and transmission of COSMIC data and to be used for future Landsat Data Continuity Mission (LDCM) support. NOAA/NESDIS currently provides the tracking ground station support for 45 polar satellite passes a day.

Many of the POES GS planned operational support activities were completed in FY10 and were incorporated into NESDIS OSO operational systems. The Multi-mission L and S-Band receivers at the Fairbanks CDA station have been replaced. Requirements were approved for the STPFS and two First Articles were successfully tested. One STPFS is operational at SOCC the other is operational at the Wallops CDAS

The Satellite Operations Management System (SOMS) software scheduling subsystem is used to automate the data transfer and support POES blind orbit at the EUMETSAT Svalbard, Norway CDAS. The IT refresh of the SOMS servers, workstations, and operating system at both SOCC and Wallops was completed in FY10.

POES GS on-going activities include resolving Anomaly Reports within various NOAA ground segments (including SOCC, CDAS, and ESPC) and with the EUMETSAT ground system. Joint operations working group meetings are held regularly to discuss and refine the joint operation issues. Status meetings are held weekly to discuss system performance, and data loss and recovery.

Data from the polar environmental satellites is received at ground facilities, where the data are processed to monitor and control the satellite and to generate products that are used by NOAA, its users, and the World Meteorological Community. The POES Ground System operational elements are located at Fairbanks, Alaska, Wallops, Virginia, and Suitland, Maryland.

The POES satellites provide critical global information in a timely manner to the National Weather Service (NWS) for input to the NWS numerical weather models and their products. POES satellites also monitor the global sea-surface temperature, indicating the location, onset, and severity of such events as El Nino as early as possible. Polar satellite data provides advance notice and continuous monitoring of impending weather events which provides emergency responders, civic leaders, and agricultural managers with longer lead times to activate their plans and thus reduce the impacts of floods, landslides, and droughts.

2.2 Business Results

2.2.1 Program Management and Controls

The POES GS supports the POES satellite programs under the Office of System Development (OSD), Ground Systems Division (GSD) management. The POES GS Project Manager is directly responsible for coordinating and leading the government team at the Technical Interface Meetings (TIMs), design reviews, coordination and status meetings, and for analyzing contractors' performance reports and task deliverables. The POES GS Project Manager writes monthly reports that include; summaries of all accomplishments, task status, a financial status which includes staff utilization, baseline and updated schedules, planned and completed activities, planned and actual costs, and analysis of all issues including risk areas and associated mitigation strategies. The POES GS monthly reports are provided to GSD senior management for review and discussion.

2.2.2 Monitoring Cost, Schedule and Performance

Cost – OSD conducts a variety of budget analyses throughout the fiscal year. Obligations and expenditures are tracked on a monthly basis. Variances to budget plans are analyzed monthly by OSD. Significant variances are reported to OSD Management as well as NESDIS management. A Needs Analysis is conducted annually in conjunction with the Planning, Programming, Budgeting and Execution System (PPBES) and Ground System processes. Key budget issues and risks are identified through these reviews and tracked by OSD management

The original baseline budget profile that was established for POES GS is a primary POES GS constraint. Budget requests from the field have historically exceeded the funding available, and are prioritized accordingly. Those projects with low priority are not funded or are added to the following fiscal years as potential projects.

Schedule –The final matrix annual operating plan for OSD includes the significant POES Ground System milestones. Key milestones are tracked monthly using the matrix annual operating plan. These tasks are tracked through Microsoft Project and Excel. POES GS program activities are within the performance thresholds for reporting based on the annual operating plan.

Performance – Contract performance is monitored to support budget and performance measurements. The majority of expenses incurred by the POES Ground System are hardware purchases. The integration of new hardware is conducted by government or contract staff. As required, contractor support can be secured through existing Operations & Maintenance contracts or through the hardware vendors. Hardware maintenance contracts are reviewed every six months for technology advances impacting system maintainability, reliability, and interoperability.

Through the POES GS, OSD provides NESDIS-wide support for various tasking, including IT Security, Program Management, Business Continuity Planning, Systems Engineering and Budgeting. These contracts are a combination of Cost Plus and Firm Fixed Price. For these contracts, OSD receives monthly status reports and meets at least quarterly with contract management to review performance, priorities, lessons learned, and work plan. A more formal review is held at the end of each contract year to assess the performance, come to agreement on ways to maximize the efficiency and productivity, and identify milestones for the next contract year.

2.3 Risk Mitigation

For developmental risks and operational programmatic risks – The OSD management team prepared risk mitigation plans in response to all identified risks. These plans include information on how the risk will be monitored and reported. When applicable, cost/benefit analysis will be performed to assess the risk vs. various mitigation actions. Several of the FY10 risks were mitigated as follows:

- Risk: Operating System IT security patching policy was out of scope with the original proposal.
  Mitigated the risk: Modified the contract to support additional IT security work.

- Risk: Implemented am updated Operating System which could introduce a waterfall effect with other processes.
  Mitigated the risk: Designed a prototype, required detail test plans, and performed extensive regression testing on both the development and operational systems.

- Risk: New upgraded servers were not equipped with the legacy interface.
  Mitigated the risk: Developed an interface that was acceptable to operations.

- Risk: The Satellite Scheduling workstations sessions were not recoverable.

Mitigated the risk: A centralized server synchronization process was developed to ensure that the scheduling sessions were recoverable.

The Configuration Control Board (CCB) meets at regular intervals to review and manage operational system risks. The CCB meetings include mitigation discussion. CCB meeting minutes are documented and kept as official records. When applicable, technical analysis and cost/benefit analysis are performed to assess the possible risk and proposed mitigation actions.

2.4 Reviews

NESDIS management reviews the POES GS program's performance against cost, schedule and satellite data delivery goals on a monthly basis. NESDIS management has concluded that the POES Ground System fully meets the customer's needs and the POES GS program is delivering necessary services to the users. All POES GS program metrics are at or above expectations.

2.5 Security

The POES Ground System is supported by federal and contractor staff, government-owned equipment, and resides in a government facility. The contracted IT services are primarily for systems engineering support. System development activities included in the POES Ground System include security planning requirements. In accordance with Commerce Procurement Memorandum 2003-09 issued November 17, 2003, Commerce Acquisition Regulation (CAR) 1352.239.73 - Security Requirements for Information Technology Resources has been incorporated into all IT services contracts. In addition, Commerce Acquisition Manual (CAM) 1337.70 - Security Processing Requirements for On-Site Service Contracts is implemented for personnel security. Security is incorporated into the investment's system life cycle in accordance with DOC IT Security Program Policy and the recommendations of NIST SP 800-64 - Security Considerations in the Information System Development Life Cycle. Contractor performance of required IT security management, operational, and technical controls is assessed in accordance with draft NIST SP 800-26 Revision 1, Security Self-Assessment Guide for Information Technology Systems, as part of the annual FISMA self-assessment of control effectiveness.

This POES Ground System OA report covers only Steady State (SS) activities. Development, Modernization and Enhancement (DME) activities are tracked through separate reports. However, after development is completed, the POES Ground System provides IT security contractor support for at least twelve months after the system has transitioned to operational status.

The required security clauses have been inserted in the two IT services contracts by the Contracting Officer and independently verified by the Information Technology Security Officer (ITSO). Upon contract award, each contractor employee who is required to access this system is approved for a NOAA badge and undergoes the appropriate background check to ensure employee trustworthiness. The Contractor Officer's Technical Representative (COTR) verifies the identity of each contractor employee and submits appropriate forms to the NOAA Security Office for a background check and employee badge. A personnel security professional within the NOAA Security Office ensures that all information provided by the COTR is correct and initiates a security background check for the contractor employee through the Office of Personnel Management (OPM).

After OPM performs the contractor employee's background check, the NOAA Security Office is notified and a personnel security specialist reviews the results of the background check and subsequently approves issuance of a NOAA badge. The expiration date of a NOAA badge worn by a contractor employee must coincide with the contract's end date. This process is repeated for each new contractor employee. Contractors supporting this investment do not store, process or transmit data/information with any of the government system(s) that contain

personal or IT security sensitive information. As a result, contractors are not required to undergo certification and accreditation activities for their information systems and are not required to submit a C&A package to the Contracting Officer and Information Technology Security Officer for these systems.

The POES GS Re-Certification and Accreditation (C&A) is in process.

2.6 Performance Measures

Table 2 shows the actual POES GS program's performance with respect to Strategic and Business Results in fiscal year 2010.

Table 2: Business Results Performance Measures

Measurement Area	Indicator	FY10 Baseline	FY10 Actual Result	Comments
Mission and Business Results	Four POES satellites and Jason-2 satellite data contribute to the polar data downloading of environmental data to POES ground system	99%	99.9%	Includes expanded environmental data gathering through international downloads to POES GS. 99.9% of total data was recovered in FY2010
Technology	Polar GS reprocessing and delivery of available data	99%	99.9%	FY2010

Source of FY10 data: Office of Satellite Operations (OSO) performance chart for September 2010. POES-GS annual performance targets and results are also contained in the POES-GS OMB BY12 Exhibit 300, Section II.E, and the POES-GS IT Dashboard monthly.

3.0 Financial Performance

3.1 Current Performance vs. Baseline

The GSD budget process evaluates and tracks POES GS funds using the following nine budget categories; antennas, radio frequency systems, telemetry and command/instruments, product generation and distribution, special projects (including security), communications systems, facilities and infrastructure, systems engineering, and IT refresh.

Figure 4 shows the cumulative planned and actual monthly costs for FY10.

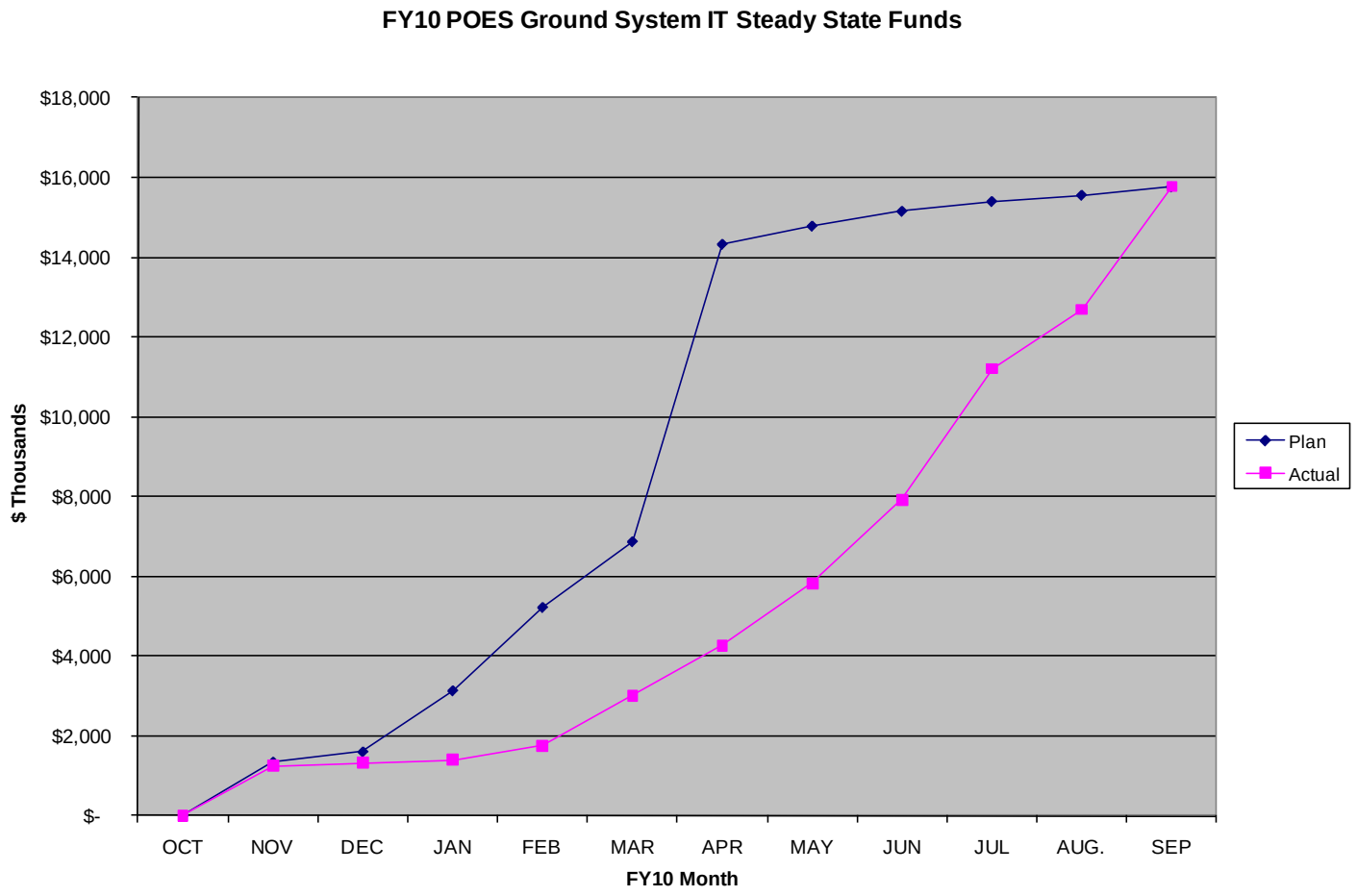


Figure 4: POES GS FY10 Cumulative Planned and Actual IT Steady State Funds

The POES GS FY10 total spending matches the planned and actual outlays for FY10 in the POES GS OMB BY12 Exhibit 300 summary of spending table.

Major activities financed in FY10 included:

- Replaced SOMS workstations and upgrade the operating system.
- Completed the Code Cleanup effort and the Global Rebuild.
- Replaced the multi-mission L&S Band receivers at the Fairbanks CDAS.
- Operationally installed two First Article STPFS, one at SOCC, one at the Wallops CDAS

For FY10, POES GS operational expenditures remain within the 10% monitoring threshold of the work plan budget.

3.2 Performance Measures

The current POES GS financial performance is based on a pre-established cost baseline (e.g., annual spend plan) program costs primarily consist of hardware, software, and contracts. During 2010, the POES GS expenditures stayed within the relevant thresholds of the Fiscal Year budget.

3.3 Cost Benefit Analysis

For the Polar GS, the incremental technology refresh strategy is intended to maintain the current POES ground system and make changes as required and as resources are available to sustain system performance throughout the satellite program lifecycles in accordance with the NESDIS strategic mission. The cost benefit analysis is documented in the POES Ground System OMB Exhibit 300, Capital Asset Plan.

3.4 Financial Performance Review

Financial performance is typically subjected to a periodic review for reasonableness and cost efficiency. Monthly budget reviews are held with the program manager, contracting officer's technical representatives (COTR) and contract managers to ensure contracts are within cost and on schedule. Monthly reports from contractors are required to ensure the Government has the information it needs to evaluate cost performance. A detailed review of work and priorities is undertaken if cost is significantly above base lined values. Also, any necessary corrective actions are also identified and implemented.

4.0 Innovation to Meet Future Customer Needs

In FY10, work was performed on the following major innovations:

- Installation of the new multi-mission L&S Band receivers at the Fairbanks CDA.
- Installation of two first article frame synchronizers, one at SOCC and one at the Wallops CDAS
- Replaced SOMS workstations and upgraded the operating system

The refresh program established by the POES Ground System provides opportunities to implement innovative solutions that will allow sustainment of the existing system. For example, the refresh of the frame synchronizers was accomplished utilizing new technology that was functionally equivalent to the current frame sync units, but at the same time providing greater operational flexibility. The current frame sync hardware is no longer in production and maintenance support for existing equipment is uncertain. The uncertainty of this outdated equipment triggered these replacement activities. The new equipment will have a longer life cycle and a maintenance component which will lower operations costs and ensure that the equipment can support the POES mission through its end of life. The frame sync refresh task is in the production process and is scheduled for completion in FY11. The replacement frame sync effort utilizes new technology to ensure that support to the current POES and the IJPS Metop missions will remain successful. In addition, these replacement components are being evaluated for their ability to also support future international polar environmental satellite missions such as JASON3 and COSMIC3 and therefore provide a cost saving to NESDIS.

4.1 Number and Types of Users

The GSD polar program transmits polar satellite data to OSO Environmental Satellite Processing Centers which produces products for use by the National Weather Service, other government agencies, and government and academic research projects. .GSD Polar programs support the international agreement with European Organization for the Exploitation of Meteorological satellites (EUMETSAT) international scientific community, and permits economies of scale in maintaining mission capabilities. Other international polar missions that GSD is committed to include the Ocean Surface Topography Mission (OSTM) and the Constellation Observing System for Meteorology Ionosphere and Climate (COSMIC) program.

4.2 Improving Technology and Meeting User Needs

The GSD polar program employs innovative solutions to operational requirements whenever possible, within budget and requirements constraints. Innovations implemented in FY10 included replacing obsolete L and S-Band receivers at the Fairbanks CDAS, and installed two first article frame synchronizers. The replacement receivers and frame synchronizers will increase efficiency and scalability of the POES GS program to support future data streams' operational requirements.

4.3 Funding Levels

Recent trends in government spending indicate that agencies should not expect significant increases in their budgets. This, coupled with the requirement to incorporate evolving technology, will force the program to find efficiencies and to do more with the same amount of resources.

4.4 Challenges, Risks Ahead, and Mitigation Strategies

4.4.1 Frame Synchronizer Task

Challenge: Install new hardware and software at SOCC and the Wallops and Fairbanks CDAS.
Risks Ahead: Failure of the frame synchronizers to deliver data to the sites 24 /7
Mitigation Strategies: Build a prototype, In-Plant testing, On-Site testing, Extended Maintenance support

4.4.2 LEO-T Task

Challenge: Removing and updating antenna global values used by multiple missions.
Risks Ahead: Changes could impact other missions control systems.
Mitigation Strategies: Technical Interface meetings will be held to discuss the impact and changes.
Spare equipment will be used for development.

4.4.3 Multi-Mission L&S Band Receiver Follow-on

Challenge: Installation of new software, firmware at Wallops and Fairbanks CDAS.
Risks Ahead: IT Security Patching and Updates can cause system failures.
Mitigation Strategies: Contractor shall perform regression testing on test bed at factory prior to release.

4.5 Example - Using Polar Satellite data to Study Global Climate Change

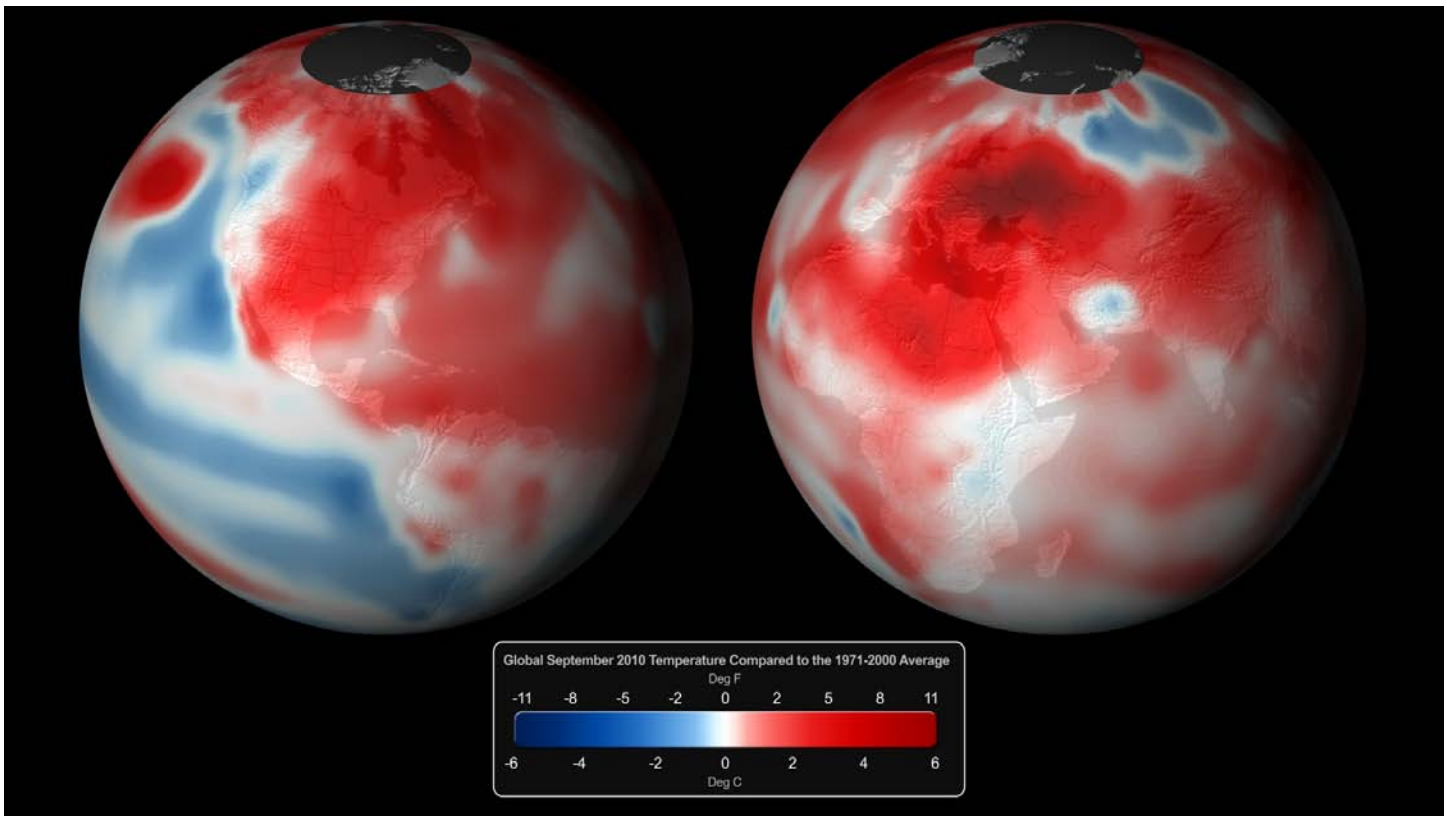


Figure 5: Polar global temperature increase due to La Nina in September 2010 compared with the 1971 – 2000 Average Temperature